est for January, but is the highest on record since the opening of the bureau. The lowest reading 29.423 inches, occurred at Oberlin, on the 1st.

The mean temperature of the air for the month, 23°.0, is but 3° below the five-year average. The highest temperature, 67°.5, occurred at Portsmouth on the 6th, and the lowest, 14°.0 below zero, at Wauseon, on the 28th. The monthly range of temperature was 81°.5, and the mean daily range, 16°.6. The greatest daily range, 39°.1, occurred at Wauseon, on the 12th, and the least, 1°.2, at Youngstown, on the 16th.

Precipitation was general throughout the state on the 1st, 5th to 9th, 12th, 13th, 15th, 17th, 25th, and 26th. Local rains or snows occurred in the northern and middle sections on the 2d, 3d, 4th, 10th, 18th, 29th, and 31st, and in southern section on the 21st and 31st. Sleet was reported from scattering stations in all sections on the 12th, 13th, 15th, and 17th. The mean monthly rainfall, 3.68 inches, is 0.70 inch above the average for the past five years. The average daily rainfall, 0.119 inch, is 0.023 inch above the mean for the month. The greatest monthly rainfall, 6.15 inches, occurred at North Lewisburg; the least, 1.92 inches, at Youngstown. The greatest daily rainfall was 2.06, at Quaker City, on the 6th.

"Oregon Weather Service," report prepared by B. S. Pague, Sergeant, Signal Corps:

Reports were received from thirteen stations, covering the Columbia River basin, the interior valleys, coast, and southern region.

Temperature (in degrees Fahr.).—The marked characteristic of the month was the extreme low temperature. From the 2d to the 21st the temperature was generally below the normal. The coldest weather ever experienced in Oregon occurred on the 14th, 15th, and 16th. Except at the coast stations, and at Albany, the temperature was from —2 at Portland, to —34 at La Grande. Linkville and Lakeview report —24, Eola —5, Roseburg —6, and Ashland —3. The mean temperature was from 5 to 12.6 below the normal at all stations. The central coast stations report the highest mean temperature, and Roseburg reports the highest mean temperature, 35, in the interior valleys; La Grande reports the lowest mean temperature, 17. On the 22d the "chinook" wind began blowing and the temperature rose rapidly in all sections; owing to the influence of this wind, the mean temperature was raised much higher than it otherwise would have been. The maximum temperature occurred from the 25th to 31st. Roseburg reports the maximum temperature, 71. The minimum temperatures reported from the coast stations are, Astoria, 10; Newport, 0.8; Bandon, 14. The extreme cold weather of the 14th, 15th, and 16th appeared in the shape of a regular cold wave, preceeded in sections by snow, and then followed by the rapid fall of the mercury. The cold wave was experienced on the entire coast, causing lower temperatures than had ever before been observed. A temperature of zero in the interior valleys of Oregon has never before been observed. The mean temperature of the state is 29.

Precipitation (in inches).—The precipitation was above the normal in all districts, the excess ranging from 0.17 at Roseburg to 5.34 at Eola. For the season, from July 1, 1887, to February 1, 1888, the precipitation is from 0.42 to 4.64 below the normal, except at Astoria and Albany, where it is above the normal. On the 28th, 29th, and 30th excessive precipitation occurred along the coast and in the Willamette Valley; on the 2d and 8d excessive precipitation occurred at Roseburg and in the southern region. Precipitation occurred on from nine to twenty days throughout the state.

The "Pennsylvania State Weather Service," report prepared under the direction of the Franklin Institute, Philadelphia, by Sergeant T. F. Townsend, Signal Corps:

The characteristics of January, 1888, were the distinctive thermal periods of abnormal warmth and cold, dividing the month into two equal parts.

The mean daily temperatures, as compared with those deduced from the records of fifteen years, show a daily excess of about 5° during the first half of the month, and a daily deficiency of about 10° during the last half. At the end of the month there was a total deficiency amounting to 49° at Pittsburg, 106° at Philadelphia, and 179° at Erie. The mean for the month was 22°.1, which is probably 5° below the normal; the highest occurred on the 1st and 7th, and ranged from 61° at Pittsburg to 40°.5 at Carlisle; the lowest were on the 22d and 23d, and the following noted: Dyberry, —19°; Wellsborough, —16°; Columbus, —15°; Eagles Mere, —14°; Greenville, —14°, and Clarion, —18°.5; the mean maxima for the month was 30°.2, and the mean minima 16°.3; these show a daily mean of 23°.2, which is 1°.1 above that obtained from the tri-daily observations at 7 a. m., 2 p. m., and 9 p. m.

The precipitation for the month amounted to an average of 4.19 inches, which is nearly one inch in excess of the monthly average. Of this amount (4.19 inches) 1.40 inches was melted snow and hail. The rain and snowfall was very unevenly distributed, and ranged from 6.75 inches at Indiana, 6.17 inches at Pittsburg, 6.04 inches at Huntingdon to 2.12 inches at Chambersburg. Excepting the 14th and 22d rain or snow fell in measurable quantities on every day in some part of the state; the greatest amount, and the most rainy days, occurred in the western portion. Most of the storms were mixtures of rain, snow, and sleet.

The "South Carolina Weather Service," Hon. A. P. Butler, Com'r of Agriculture for South Carolina, Columbia, director:

The month has been unusually warm, the temperature being above the average for the month. The mean temperature for the state, 46°.2, is 6°.1 higher than for January, 1887. No general storm has moved directly over the state, although an area of low barometer appeared over Alabama and the Gulf on the morning of the 1st. The greatest amount of precipitation occurred on that day, the average for the state being over 1.25 inches. The average rainfall for the month (2.94 inches) is slightly higher than for same month last year; also number of days on which rain fell. The greatest amount of precipitation occurred in the middle counties.

Summary.

Temperature (in degrees Fahrenheit).—Monthly mean, 46.2; highest monthly mean, 52.5, at Hardeeville; lowest monthly mean, 43.2, at Brewer Mines; maximum, 76, at Charleston, on the 31st; minimum, 15, at Cheraw and Brewer Mines, on the 19th; range for state, 61; greatest local monthly range, 60, at Cheraw and Brewer Mines; least local monthly range, 49, at Newberry; greatest daily range, 34, at Hardeeville, on the 28th; least daily range, 2, on the 23d, at Winnsborough.

Precipitation, including melted snow (in inches).—Average for state, 2.94; greatest, 5.52, at Abbeville; least, 1.21, at Marion.

Wind.—Prevailing direction, northwest.

The following is an extract from the report of the "Meteorological Department of the State (Tennessee) Board of Health," prepared under direction of J. D. Plunket, M. D., President of the State Board of Health, by H. C. Bate, Signal Corps, Assistant, Nashville:

The month of January was marked by no special features except the remarkable sleet of the 15–16th, which remained on the ground for ten days in most parts of the state. There were no very high winds reported except at Greeneville, and only one thunder-storm, which was confined to the western division. The percentage of cloudiness was large, and while the temperature was always above zero, the month was generally a very disagreeable one.

The mean temperature was 37°.8, about 4° above the normal for the past five years. The highest temperature was 74°, recorded on the 6th and 7th, and was the highest January maximum since 1884, when it was the same, the lowest during the period being 61°, in 1886. The lowest temperature was 2°, recorded on the 16th and 19th, and was the highest January minimum recorded in the past five years, the next being —2°, in January of last year. The lowest minimum during the period was —23°, reported at Sunbright, January 11, 1886. On that day and the day following the temperature was reported from —14° to —20° at several stations throughout the state. The mean minimum temperature for the month of that year was —10°.74. The ranges of temperature were generally less than usual, but in one instance—at Nashville, on the 15th—the daily range was 45°, a very unusual range.

The mean precipitation for the month was 4.47 inches, about one inch less than the January average of the past four years, and the least during that period. Of this amount the eastern division received an average of 4.76 inches, the middle division 4.20 inches, and the western division 4.45 inches. Much of this precipitation was sleet and snow, especially that portion which fell on the 15th to 20th. The days of the greatest precipitation were the 8th, 9th, 12th, 15th, 16th, and 17th, that on the last-named date being confined mostly to the eastern division. The greatest daily precipitation occurred on the 12th, and the greatest daily local precipitation was 2.18 inches, reported on the 1st at Chattanooga. There were seven days reported without measurable rainfall, viz., 2d, 8d, 19th, 24th, 26th, 27th, and 28th. The greatest monthly precipitation was 7.16 inches reported at Cookeville, and the least, was 2.40 inches, reported at Sunbright, about fifty miles east from the former station. The mean depth of snowfall was 2.79 inches. Frost was reported at various stations on twenty-seven days—the 5th, 6th, 30th, and 31st being the only days reported free from frost.

NOTES AND EXTRACTS.

CHINOOK WINDS.

[By Junior Prof. H. A. HAZEN.]

The term "Chinook" was originally applied to a south or southwesterly wind blowing over Washington Territory and British America from the region formerly inhabited by the Chinook Indians on the banks of the lower Columbia River. The name is now applied to any rather strong southwesterly to northerly wind which is warm and dry blowing to the east of the Rocky Mountains. Its lower limit, roughly speaking, is at the forty-fourth parallel, and it may extend eastward to Dakota. Its principal characteristic is the power of melting or almost drying up the snow, as frequently no water runs from it. One of the first published notices of it to be found is in the volume of the Canadian Geological Survey, 1879–'80, page 77, by Mr. G. M. Dawson. The following are some of the more recent notes regarding it: "Science," August 29, 1884, page 166; December 25, 1885, page 556; January 8, 1886, page 33; January 15, 1886, page 55; "American Meteorological Journal," May, 1885, page 18; November, 1886, page 330; December, 1886, page 342; February, 1887, page 467; March, 1887, pages 507 and 516; August, 1887, page 182; September, 1887, page 224.

The following are some extracts from the above writings: Mr. Ingersoll

says: "On the plains about Calgary, latitude 51° N., snow disappears rapidly under the influence of the warm, dry wind sweeping up from the great Utah and Columbia basins, which people there erroneously call Chinook." Mr. G. M. Dawson says: "The Chinook is a strong westerly wind, becoming at times almost a gale, which blows from the mountains across the plains. It is extremely dry, and, as compared with the general winter temperature, warm." Professor Harrington says: "They are warm, dry westerly or northerly winds occurring on the eastern slopes of the mountains of the Northwest, beginning at any hour of the day and continuing from a few hours to several days."

The wind is generally considered by writers to be similar to the "Föhn" of the Alps, which is believed to be caused largely by the fact that an ascension of the air to the top of the mountains on the west side serves to abstract nearly all the moisture, and liberation of latent heat warms it so much that it descends on the east a warm, dry wind. This explanation for the "chinook," however, will not hold for the reason that it is felt on the plains where there are no mountain ranges near. The most remarkable circumstance is that a wind from the northwest, which ordinarly brings intense cold, brings great heat. One of the facts developed by Professor Harrington's study of the actual conditions, has been the existence of a well-developed storm or low pressure area to the northward almost without exception. This seems to increase the difficulty in obtaining a true cause for the wind, because, ordinarily, upon the passage of such a low area the westerly or northwesterly wind, while very dry, is also intensely cold as compared with that just preceding.

In order to investigate the conditions preceding these winds it was decided to take out all the cases occurring since the maps of the International Bulletin were begun. The months October to March were studied and all the cases having dry and relatively warm winds from west to north at Virginia City and Helena were selected.

Each of these instances was studied in connection with the international chart giving isobars and isotherms north of the equator. The largest number of cases occurred when there was a low area to the northward, extending far into the Pacific; the next largest occurred with a prominent high area in the plateau between the Cascade Range and the Rocky Mountains. A few cases occurred with the high area a little farther north. The explanation, then, seems to be the prevalence of a low area to the northward, bringing in air along the southern border from the warm and arid plains and not having a reinforcement of cold air from the northward, as there is no high area in that region, but the low area extends far out upon the Pacific. The same result is brought about when the high area is to the southwestward, causing winds from the west, which are warmed in the arid plateau regions by winds from the south.

The following table shows the more pronounced of these cases:

Dates of chinook winds in northern Montana.

1877.	1880.	1882.
1. November 15.	19. January 1.	37. February 5.
2. December 8.	20. January 15.	38. February 15.
	21. January 21.	39. February 26.
1878.	22. October 7.	40. March 1.
	23. October 20.	41. March 19.
3. January 10.	24. October 24.	42. March 27.
4. February 11.	25. November 1.	43. October 8–24.
5. February 18.		44. November 22.
6. October 22.	1881.	45. December 2.
7. March 21.		46. December 23.
8. December 2.	26. January 4.	
	27. February 2.	1883.
1879.	28. February 22.	
	29. March 1.	47. January 6.
9. January 24.	30. March 25.	48. November 22.
10. February 23.	31. October 7.	49. November 6.
11. February 26.	32. October 30.	50. November 29.
12. March 6.	33. November 26.	51. December 16.
13. March 29.	34. December 8.	
14. October 5.	35. December 15.	1884.
15. October 13.		
16. October 28.	1882.	52. February 24.
17. November 6.		53. March 17.
18. December 15.	36. January 1–7.	54. March 26–31.

ANNUAL SUMMARY FOR 1887.

With this REVIEW are issued two additional charts (numbers v and vi) showing respectively the annual isotherms and departures from the normal temperatures for 1887, and the annual precipitation for the same year.

As the more noteworthy meteorological features of the year, may be mentioned: 1st, the large deficiency of rainfall over the central valleys and Southern States, which resulted in the most protracted and disastrous drought that has been known for many years; 2d, the unusually warm weather which prevailed in the northern and central portions of the country east of the Mississippi River in July, during which month many stations reported the highest temperatures recorded since their establishment.

In the table below are given for the Signal Service stations for 1887, the annual mean temperatures; departures from normal temperature; maximum and minimum temperatures, with dates of occurrence; total precipitation; departures from normal, and percentages of normal precipitation. The records from which the normals are computed are not of uniform duration, but for the most part cover periods of twelve to fifteen years:

Stations and districts.	Temperature—degrees Fahrenheit.						Precipitation in inches.		
	Mean for 1887.	Departure from normal.	Extremes for 1887.				Total for 1887.	Departure from normal.	Percentage of normal.
			Maximum.	Date of maximum.	Minimum.	Date of minimum.			
New England.									
Eastport	41.2	—0.1	83.8	July 3	—13.4	Jan. 19	47.0	— 3.5	93
Portland	44.4	—2.3	95.8	July 2	—14.7	Jan. 9	49.1	+ 9.3	123
Nantucket	49.2	.....	83.9	July 13	5.2	Jan. 19	37.3	.....	....
Boston	48.2	0.0	95.1	July 2	— 5.0	Jan. 19	33.8	—14.3	70
Block Island	49.7	+0.3	83.4	July 30	1.8	Jan. 19	44.6	— 7.3	86
New London	49.6	+0.3	80.9	July 13	— 0.1	Jan. 19	48.0	— 0.7	98
New Haven	48.6	—1.1	90.2	June 30 / July 13	—5.4	Jan. 19	44.1	— 5.8	88
Middle Atlantic states.									
Albany	47.6	—0.6	95.0	July 13	—15.3	Jan. 19	39.7	+ 1.9	105
New York City	51.9	+0.7	94.0	July 16	6.0	Jan. 19	46.6	+ 3.2	107
Atlantic City	51.8	—0.1	97.0	July 18	7.0	Jan. 19	37.9	— 4.9	89
Philadelphia	53.8	+0.7	99.9	July 16	8.1	Jan. 3	42.2	+ 1.6	104
Baltimore	54.6	—0.9	101.8	July 18	7.3	Jan. 3	43.6	+ 1.1	103
Washington City	54.8	—0.1	102.8	July 18	6.2	Jan. 3	35.1	— 8.4	81
Norfolk	58.4	—0.8	102.5	July 18	12.6	Jan. 19	47.7	— 3.3	94
Lynchburg	56.4	—0.8	101.8	July 18	6.1	Jan. 4	40.6	— 2.2	95

Table of annual mean, departures from normal, and maximum and minimum temperatures, &c.—Continued.

Stations and districts.	Temperature—degrees Fahrenheit.						Precipitation in inches.		
	Mean for 1887.	Departure from normal.	Extremes for 1887.				Total for 1887.	Departure from normal.	Percentage of normal.
			Maximum.	Date of maximum.	Minimum.	Date of minimum.			
South Atlantic states.									
Hatteras	61.4	—0.1	89.4	July 17	19.8	Jan. 19	55.1	—18.9	74
Raleigh	58.3	.....	103.0	July 18	8.4	Jan. 4	59.2	.....	....
Wilmington	62.5	—0.7	100.0	July 17, 18	14.6	Jan. 19	51.5	— 6.3	89
Charlotte	59.5	—0.8	102.2	July 18	8.2	Jan. 4	51.2	— 3.5	94
Augusta	63.6	—0.7	103.8	July 17, 18	14.7	Jan. 4	45.1	— 3.9	92
Charleston	64.9	—1.0	99.6	June 19	16.7	Jan. 4	44.7	—15.8	74
Savannah	65.1	—1.7	101.6	July 18	16.0	Jan. 4	44.6	— 9.5	82
Jacksonville	68.1	—1.7	100.3	July 18	21.9	Jan. 4	58.6	+ 1.4	102
Florida Peninsula.									
Cedar Keys	69.4	—1.3	92.1	July 20	24.0	Jan. 4	44.2	—14.1	76
Key West	76.1	—1.4	89.9	July 23	50.2	Jan. 4	43.6	+ 3.9	110
East Gulf states.									
Atlanta	61.2	—0.1	100.0	July 19	9.0	Jan. 2	50.4	— 6.0	89
Montgomery	65.5	+0.1	102.0	June 19	12.9	Jan. 3	44.7	— 8.9	83
Pensacola	68.1	+0.1	98.6	July 29	20.3	Jan. 3	52.3	—15.6	77
Mobile	66.7	—0.2	97.5	July 29	15.9	Jan. 3	52.0	—13.8	79
Vicksburg	65.7	+0.1	97.3	June 19	9.6	Jan. 3	42.2	—18.6	69
New Orleans	68.4	—0.7	95.8	July 31	21.4	Jan. 3	65.0	+ 0.6	101
West Gulf states.									
Fort Smith	60.8	+1.8	103.8	July 31	— 4.0	Jan. 3	38.7	— 4.3	90
Shreveport	66.0	+0.5	103.8	July 31	12.0	Jan. 3	42.2	—12.2	78
Palestine	65.1	+0.6	101.5	July 22	10.6	Dec. 21	38.0	— 7.9	83
San Antonio	68.1	—1.0	100.9	June 1 / July 24	16.8	Jan. 3	20.1	—12.4	62
Galveston	69.7	—0.4	93.4	July 23	23.5	Jan. 10	43.4	— 9.6	82
Rio Grande Valley.									
Rio Grande City	72.8	—0.5	108.3	May 1	25.0	Jan. 10	32.2	+ 9.2	140
Brownsville	71.1	—1.5	92.7	Aug. 17, 26	26.2	Dec. 22	59.9	+27.0	182
Tennessee.									
Nashville	59.8	+0.3	99.3	Aug. 3	— 1.8	Jan. 2	48.4	— 4.5	91
Memphis	61.9	+0.9	99.0	July 31	4.3	Jan. 3	42.5	—12.2	78
Chattanooga	60.1	+0.1	99.2	July 19	7.4	Jan. 2	51.1	— 8.3	86
Knoxville	58.8	+1.6	100.2	July 19	5.4	Jan. 3	43.0	—11.0	80
Ohio Valley.									
Pittsburg	54.1	+2.2	101.2	July 17	4.0	Jan. 4, 19	42.0	+ 5.3	114
Columbus	52.8	+0.7	100.2	July 17	— 5.0	Jan. 2, 11	30.2	—12.1	71
Indianapolis	52.6	—0.2	100.8	July 30	—11.8	Jan. 3	33.1	—13.4	71
Cincinnati	55.3	—0.3	101.2	July 18	— 5.2	Jan. 3	35.1	— 8.0	81
Louisville	57.7	+1.0	101.7	July 29	— 4.7	Jan. 2	38.2	—10.8	78
Lower lake region.									
Detroit	48.4	+0.3	101.0	July 17	— 3.0	Jan. 11	29.0	— 5.4	85
Toledo	48.8	—1.2	98.6	July 17	—10.3	Jan. 11	32.0	— 0.8	98
Sandusky	49.3	—1.1	98.0	July 17	— 8.0	Jan. 11	29.9	— 9.7	75
Cleveland	49.3	+0.5	95.2	July 17	— 5.9	Jan. 11	35.4	— 2.8	93
Erie	48.1	—1.0	93.6	Aug. 4	— 3.5	Jan. 11	45.1	+ 1.7	104
Buffalo	46.8	+0.4	94.2	Aug. 4	— 1.7	Jan. 18	31.6	— 6.5	83
Rochester	46.3	—0.4	95.0	July 16	— 4.6	Jan. 18	20.3	—15.9	56
Oswego	45.2	—1.9	90.4	July 16	— 9.6	Jan. 8	23.4	—12.1	66